



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

FLIGHT OF MOSQUITOES.

STUDIES ON THE DISTANCE OF FLIGHT OF ANOPHELES QUADRIMACULATUS.

By J. A. A. LE PRINCE, Sanitary Engineer, and T. H. D. GRIFFITTS, Assistant Epidemiologist, United States Public Health Service.

In connection with measures for malaria control, it is of great importance to know how far the control of mosquito production should be extended in order to prevent *Anopheles* from conveying malaria to the community.

In the Southern States *Anopheles quadrimaculatus* is probably the principal carrier of malaria. The extent to which *Anopheles punctipennis* or *Anopheles crucians* may transmit the disease has not yet been determined. While the relative importance which should be attached to each of these species of mosquitoes as factors in the actual conveyance of malaria is still under investigation, sufficient evidence is at hand to justify the statement that *A. quadrimaculatus* is by far the most efficient vector of the three. For this reason the studies of flight distance have been devoted to *A. quadrimaculatus*, although it is important that the distance of flight of the other species should likewise be determined.¹

In connection with malarial investigations on impounded waters 1914-15, opportunities were afforded to determine how far from known breeding places *Anopheles* could be found. Numerous inspections of the interiors of buildings indicated that *A. quadrimaculatus* was very rarely present more than a mile from the breeding area, even though the latter was very prolific. This species was never found in houses and barns located at distances of $1\frac{1}{4}$ miles and more from the most prolific breeding places. Persons living $1\frac{1}{2}$ miles from such areas reported an entire absence of mosquitoes.

In 1916 experiments were undertaken at Stevens Creek and Fort Lawn, S. C., in order that more exact data concerning the flight range of *A. quadrimaculatus* might be obtained.

From previous investigations conducted at Stevens Creek, which is located about 10 miles from North Augusta, S. C., it was known that a body of impounded water at that place formed a prolific breeding area for *A. quadrimaculatus*, and that a heavy house infestation of this species existed in that general vicinity. It had also been observed that the number of *A. quadrimaculatus* in occupied houses and barns became progressively smaller as the distance from the body of impounded water increased. This led to the conclusion that the en-

¹ The ultimate goal should be the determination of the distance of contaminating flight. It is possible that the maximum flight of the *Anopheles* mosquito is that which she makes to obtain her first blood meal, and she is not infective to man until 10 to 14 days later. This may explain the fact that the great flight at Gatun in 1913 did not increase the malaria rate at that place.

gorged mosquitoes found in the occupied buildings had come mainly from the breeding place mentioned.

The experiments were planned on the same lines as those carried out with the flight of a Panama species, *A. tarsimaculata*, at Gatun. Accordingly, a large number of *A. quadrimaculata* was captured alive for the test, the sources from which they were taken and the methods of capture being as follows:

1. Mosquito nets were placed close to the breeding places at night, and the *Anopheles* were attracted into the nets by men who served as bait. The *Anopheles* were stained in the nets by spraying with a 1 per cent aqueous solution of eosin (yellowish) from an atomizer and liberated.
2. Resting *Anopheles* were caught in heavily infested houses in the daytime by means of a hand collecting device.

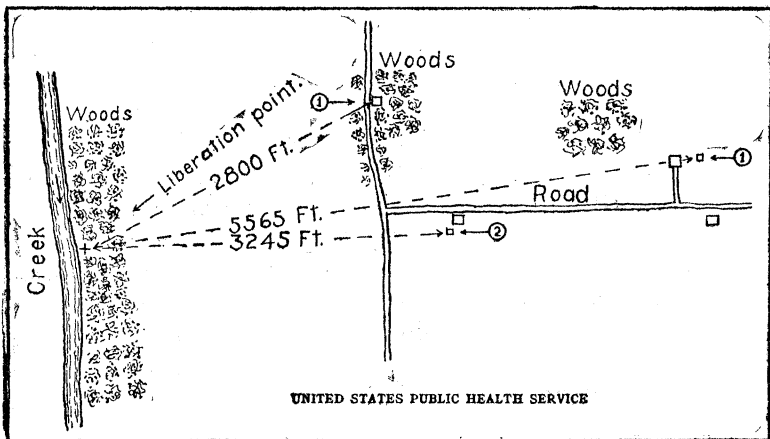


FIG. 1.—Sketch showing relative location point and barns where stained *Anopheles* were recaptured, North Augusta, S. C.

The mosquitoes were taken to a point in the breeding area which had been selected as a liberation station. They were then stained as above described and allowed to escape. On the first day only a few were set free, but on the second day a large number was liberated, all at one point.

For 10 days following the liberation of the first batch of stained mosquitoes daily catches were made in inhabited houses, barns, and stables within a distance of $1\frac{1}{2}$ miles from the place of liberation. During this period 1,542 anopheles were captured and examined for stain.

The first stained specimen was recovered on the third day after the liberation of the first batch. This positive specimen was found at a distance of 5,565 feet from the liberation station. On the following day the second specimen was caught at 2,800 feet. Two others

were captured on the sixth day at 3,245 feet. All of the stained specimens recovered were engorged, and were taken during the day-time, apparently near where they fed. By referring to Figure 1 it will be seen that the flight from the liberation station was divergent.

The topography, as shown by figures 1 and 2, is such that the houses or barns could be seen for only a short distance.

At Fort Lawn, S. C., the staining station selected was on the Catawba River and about 18 miles from Chester, S. C. At this place the land rises rapidly from the edge of the river, and it was desired to determine if *A. quadrimaculatus* would fly across the river.

A point for the liberation of the specimens was selected on the east bank where there were only one or two houses within 1 mile. On the west shore houses were more numerous and there were cattle in the fields—a plentiful blood supply.

Anopheles quadrimaculatus were fairly numerous in houses from one-quarter to one-third of a mile from the river. This species was

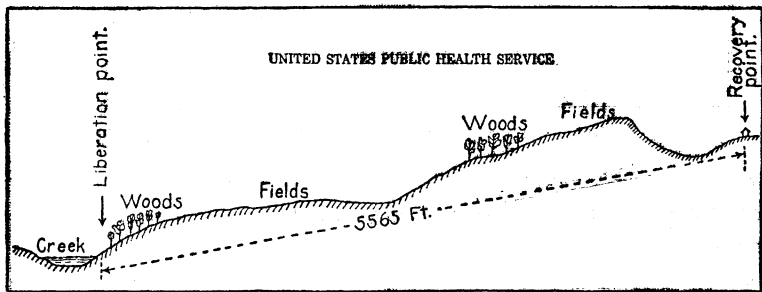


FIG. 2.—Profile of path of flight at North Augusta, S. C.

very scarce in houses one-half mile from the river, and could not be found in houses 1 mile distant.

About 270 *A. quadrimaculatus* and 30 *A. punctipennis* were captured in houses and barns within one-half mile of the Catawba River on the west side. These were stained with a 1 per cent solution of eosin and liberated from the point selected on the east side. Within 72 hours two of them, *A. quadrimaculatus*, were found in a negro shack on the west side of the river. A third *A. quadrimaculatus* was taken at the same place on the following day. It is worthy of note that a large per cent of the *Anopheles* originally captured for the experiment came from the cabin where the stained specimens were recovered later. The flight distance was 3,090 feet from the point of liberation, providing the flight was in a direct line, 800 feet of which was over the waters of the Catawba River.

An examination of many houses from three-quarters of a mile to a mile distant from the river proved negative. The production of *Anopheles* at Fort Lawn was much less extensive than at North Augusta,

and so far as could be determined by house examination the average maximum flight distance was shorter. This might have been expected on account of the less prolific breeding and the more convenient blood supply.¹

Summary.

(1) Observations on the flight of *Anopheles quadrimaculatus* in nature showed the flight to extend to approximately a mile from a breeding place producing very profusely. Beyond this distance stained specimens were not found.

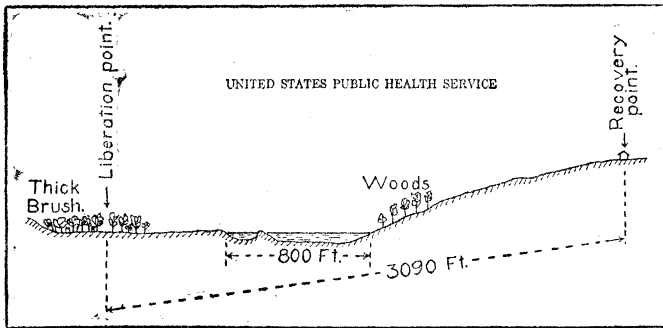


FIG. 3.—Profile of path of flight at Fort Lawn, S. C.

(2) The distance of flight from a place producing very freely but less profusely than the above was decidedly less—approximately a half mile.

(3) Stained specimens of *A. quadrimaculatus* were taken as follows: One at 5,565 feet from the point of liberation; two at 3,245 feet; three at 3,090 feet; one at 2,800 feet.

4. *A. quadrimaculatus*, in one test, flew across a river 800 feet wide in returning to a plantation from which they were originally caught for the test.

Approximately 900 or 1,000 mosquitoes were liberated.

¹ See Reprint No. 244, P. H. Reports, page 11. Also Carter, H. R. The Effect of Impounded Waters on the Incidence of Malaria, Southern Medical Journal, March, 1915.